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EXAMINER	
MUTSCHLER, BRIAN L	
ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 12/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/762,582	HONGO ET AL.
	Examiner	Art Unit
	Brian L. Mutschler	1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 27 October 2003.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 24-35 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 24-35 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 27 October 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 20031027.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Comments

1. Applicant's cancellation of claims 1-23 and addition of claims 24-35 in the response received on October 27, 2003, is acknowledged.

2. The objection to the specification has been overcome by Applicant's amendment.

3. The objection to minor informalities in claims 9 and 21 has been overcome by Applicant's cancellation of the claims.

4. The rejection of claims 3-9 and 11-23 under 35 U.S.C. § 112, second paragraph, has been overcome by Applicant's cancellation of the claims.

5. The rejection of claim 2 under the judicially-created doctrine of obviousness-type double patenting has been overcome by Applicant's Terminal Disclaimer filed on October 27, 2003.

6. It is noted that the scope of the apparatus claims that are presented has changed. Instead of plating tanks, as originally presented, the independent claim now recites plating baths. The rejections set forth in the prior Office action have therefore been modified to reflect the change in scope from containers to solutions.

Terminal Disclaimer

7. The terminal disclaimer filed on October 27, 2003, disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of U.S. Pat. No. 6,294,059 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Drawings

8. The drawings were received on October 27, 2003. These drawings are acceptable.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 24 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi et al. (U.S. Pat. No. 5,437,777).

Uzoh et al. disclose a method for plating a semiconductor substrate comprising the steps of depositing a seed layer **6** by an electroless plating method (col. 3, lines 66-67) followed by forming a conductive metal layer **8** by electroplating copper on the seed layer **6** using a plating bath (col. 4, lines 25-47). An apparatus comprising plating baths is inherent in the use of the method.

The apparatus used by Uzoh et al. differs from the instant invention because Uzoh et al. do not disclose a transfer mechanism having an arm for transferring the substrate between the baths, as recited in claim 24, and a holding stage, as recited in claim 27.

Regarding claims 24 and 27, Kishi et al. disclose an apparatus for forming metal wiring patterns comprising a robot unit **19** for inverting and feeding the substrates to a plurality of tanks **3a** to **3h** (fig. 4; col. 4, lines 1-9). A second transfer unit is shown in Figure 3, which is associated with a substrate holder **16** and comprises an arm. The apparatus also comprises a substrate holder **16** that holds the substrate in place while being plated (fig. 3; col. 4, lines 10-23). The apparatus is used for both electroplating and electroless plating (col. 1, lines 7-10).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Uzoh et al. to use a transfer mechanism as taught by Kishi et al. because the use of a transfer mechanism would automate the system and increase the efficiency of operation.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Uzoh et al. to use a holder stage as taught by Kishi et al. because the substrate holder holds the substrate steadily in position as it is being treated.

11. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi et al. (U.S. Pat. No. 5,437,777), as applied above to claims 24 and 27, and further in view of Ting et al. (U.S. Pat. No. 6,017,437).

Uzoh et al. and Kishi et al. teach an apparatus having the limitations recited in claims 24 and 27 of the instant invention, as explained above in section 10.

The apparatus described by Uzoh et al. and Kishi et al. differs from the instant invention because they do not disclose that the apparatus further comprises a cleaning and drying device for cleaning and spin drying the substrate after electroplating, as recited in claim 25.

Ting et al. disclose an apparatus for electroplating a semiconductor comprising an electroplating bath and a rinsing (cleaning) and drying device capable of spinning to enhance rinsing and drying (col. 11, line 57 to col. 12, line 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus described by Uzoh et al. and Kishi et al. to use a cleaning and drying device as taught by Ting et al. because a cleaning and drying device removes excess plating solution, which could negatively affect the performance of the electronic device.

12. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi et al. (U.S. Pat. No. 5,437,777), as applied above to claims 24 and 27, and further in view of Patton et al. (U.S. Pat. No. 6,156,167).

Uzoh et al. and Kishi et al. describe an apparatus having all of the limitations recited in claims 24 and 27 of the instant invention, as explained above in section 10.

The apparatus described by Uzoh et al. and Kishi et al. differs from the instant invention because they do not disclose that the electrolytic plating bath has a shielding plate having an opening, as recited in claim 26.

Patton et al. disclose an apparatus for electroplating semiconductor wafers comprising shields **69A** and **69B** having openings to shape the electric field between the anode **67** and the wafer **36** (fig. 1; col. 6, lines 41-43).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus described by Uzoh et al. and Kishi et al. to use a shielding plate as taught by Patton et al. because a shield plate shapes the electric field between the anode and the wafer, which allows better control of the plating process.

13. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi et al. (U.S. Pat. No. 5,437,777), as applied above to claims 24 and 27, and further in view of Lando (U.S. Pat. No. 3,776,770).

Uzoh et al. and Kishi et al. describe an apparatus having the limitations recited in claims 24 and 27 of the instant invention, as explained above in section 10.

The apparatus described by Uzoh et al. and Kishi et al. differs from the instant invention because they do not disclose that the apparatus further comprises an activation bath and a catalyst application bath, as recited in claim 28.

Lando discloses an apparatus for selectively depositing metal on the surface of a substrate comprising an electroless plating bath and an electrolytic plating bath (col. 2, lines 21-45). Before immersing the substrate in the electroless plating bath, the substrate is first immersed in a sensitizing solution (equivalent to the activating solution of the instant invention, i.e., both are disclosed as tin compounds) followed by

immersion in an activating solution (equivalent to the catalyst application bath of the instant invention, i.e., both are palladium catalyst baths) (col. 2, lines 21-45). The activation and catalyst baths are used to catalyze the electroless plating.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus described by Uzoh et al. and Kishi et al. to use an activating bath and catalyst application bath as taught by Lando because the activating bath and catalyst application bath catalyze electroless plating on the substrate.

14. Claim 29 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi et al. (U.S. Pat. No. 5,437,777), as applied above to claims 24 and 27, and further in view of Uzoh (U.S. Pat. No. 6,117,784) and Miyazawa et al. (U.S. Pat. No. 4,303,443).

Uzoh et al. and Kishi et al. describe an apparatus having the limitations recited in claims 24 and 27 of the instant invention, as explained above in section 10.

Regarding claim 29, Uzoh et al. further disclose that the plating solution comprises an acidic copper plating bath having sulfuric acid, copper sulfate, chloride ions and brighteners such as polyalkylene glycols (the compounds having the basic formula [B] recited in claim 9 of the instant invention) (col. 4, lines 25-64). Additionally, Uzoh et al. disclose the use of other additives, such as sulfur-containing compounds such as disulfides and safranine-type dyes, and nitrogen containing compounds (col. 4, lines 48-64).

The apparatus described by Uzoh et al. and Kishi et al. differs from the instant invention because they do not disclose that the electroless plating bath does not include an alkali metal. (It is noted that the plating bath of Uzoh et al. as disclosed does not contain alkali metals; the following rejection provides for alternatives to the use of alkali metals in the event additional compounds would be desired.)

In US '784, Uzoh discloses a method similar to the method disclosed by Uzoh et al. in US '234 to form a wiring pattern on a semiconductor substrate. The copper may be electroplated or electrolessly plated using an acidic copper plating bath having the same components as the bath disclosed in US '234: copper sulfate, sulfuric acid, chloride ions, polyalkylene glycols, sulfur-containing compounds and nitrogen-containing compounds (col. 3, line 38 to col. 4, line 9).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used an acidic plating bath having the components disclosed by Uzoh et al. for electrolessly plating copper because in US '784, Uzoh teaches that copper can be electroplated or electrolessly plated using an acidic copper plating bath with the same components.

Miyazawa et al. teach the use of a copper plating solution comprising a source of cupric ions and additives, wherein pH regulators can be used to maintain the pH at a basic pH of 11-13.5 (col. 3, lines 63-68). Such pH regulators can include alkali metal hydroxides, alkaline earth metal hydroxides and ammonium hydroxide (col. 3, lines 63-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made that the plating bath of Uzoh et al., if required to achieve desired results, could use a pH regulator such as alkaline earth metal hydroxides or ammonium hydroxide, which can be used equivalently to alkali metal hydroxides to control the pH, as taught by Miyazawa et al. As indicated by Miyazawa et al., the use of such regulators is optional, meaning that their use is a result effective variable, and one skilled in the art would be capable of making the appropriate determination of using or not using the compounds.

15. Claims 30-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al. (U.S. Pat. No. 6,140,234) in view of Kishi et al. (U.S. Pat. No. 5,437,777), as applied above to claims 24 and 27, and further in view of Uzoh (U.S. Pat. No. 6,117,784) and in view of either Dahms et al. (U.S. Pat. No. 5,849,171) or Dahms et al. (U.S. Pat. No. 5,433,840), herein referred to as US '171 and US '840, respectively.

Uzoh et al. and Kishi et al. describe an apparatus having the limitations recited in claims 24 and 27 of the instant invention, as explained above in section 10.

Regarding claims 30-35, Uzoh et al. further discloses that the plating solution comprises an acidic copper plating bath having sulfuric acid, copper sulfate, chloride ions and brighteners such as polyalkylene glycols (the compounds having the basic formula [B] recited in claim 9 of the instant invention) (col. 4, lines 25-64). Additionally, Uzoh et al. disclose the use of other additives, such as sulfur-containing compounds

such as disulfides and safranine-type dyes, and nitrogen containing compounds (col. 4, lines 48-64).

The apparatus described by Uzoh et al. and Kishi et al. differs from the instant invention because they do not disclose the following:

a. The electroless plating bath has a concentration of copper sulfate of 100 to 250 g/L, as recited in claim 30.

b. The electroless plating bath has a concentration of sulfuric acid of 10 to 100 g/L, as recited in claim 31.

c. The electroless plating bath has a concentration of chlorine ions of 0 to 100 mg/L, as recited in claim 32.

d. The electroless plating bath has a sulfur compound expressed by formula [A] at a concentration of at least 0.14 to 70 μmol/L, as recited in claim 33.

e. The electroless plating bath has a macromolecular compound expressed by formula [B] at a concentration of 10 to 5000 mg/L, as recited in claim 34.

f. The electroless plating bath has a nitrogen compound at a concentration of 0.01 to 100 mg/L, as recited in claim 35.

In US '784, Uzoh discloses a method similar to the method disclosed by Uzoh et al. in US '234 to form a wiring pattern on a semiconductor substrate. The copper may be electroplated or electrolessly plated using an acidic copper plating bath having the same components as the bath disclosed in US '234: copper sulfate, sulfuric acid,

chloride ions, polyalkylene glycols, sulfur-containing compounds and nitrogen-containing compounds (col. 3, line 38 to col. 4, line 9).

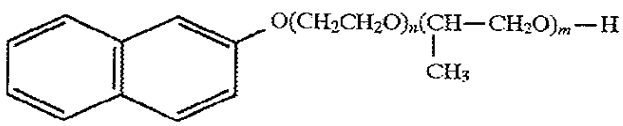
It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used an acidic plating bath having the components disclosed by Uzoh et al. for electrolessly plating copper because in US '784, Uzoh teaches that copper can be electroplated or electrolessly plated using an acidic copper plating bath.

Regarding claims 30-35, US '171 discloses a plating solution for plating copper, wherein plating bath contains a solution comprising 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 0.02-0.25 g/L of sodium chloride (NaCl), which provides chlorine ions at a concentration of 12-151 mg/L (col. 4, lines 15-28).

US '171 also discloses the use of a sulfur-containing additive, which can include bis-(w-sulfopropyl)-disulfide disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 54-67). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 μmol/L (col. 4, line 55).

The plating solution in Example 1 of US '171 further comprises 0.02 g/L (20 mg/L) of a nitrogen-containing compound, 7-dimethylamino-5-phenyl-phenazonium chloride (col. 4, lines 57-58).

US '171 also discloses the use of polyethylene glycol and polypropylene glycol polymers and copolymers having the basic formula recited in formula [B] of the instant invention. The plating solution contains a β-naphtholalkoxylate shown by the general formula below, where n=0-50 and m=0-50:



In Example 1, US '171 teaches the use of 25 mg/L of the β-naphtholalkoxylate shown above, as well as 200 mg/L of polyethylene glycol (col. 4, line 54 to col. 5, line 4).

When the plating bath taught in US '171 is used, the plating has "a mirror finish and is well smoothed" and has no voids (col. 5, lines 1-4).

Regarding claims 30-35, US '840 discloses a plating solution and a method for using a plating solution for plating the conductors of printed circuits, wherein the plating solution comprises 20-250 g/L of copper sulfate ($CuSO_4 \cdot 5H_2O$), 50-350 g/L of sulfuric acid (H_2SO_4), and 10 to 180 mg/L of chloride ions (col. 3, lines 68 to col. 4, line 8).

US '840 discloses the use of 7-dimethylamino-5-phenyl phenazonium chloride, which is a nitrogen-containing compound (col. 4, lines 45-46).

US '840 discloses the use of bis-(ω-sulfopropyl)disulfide, disodium salt, which has the chemical formula, $NaSO_3(CH_2)_3S\text{-}S(CH_2)_3SO_3Na$ (col. 4, lines 41-42). The sulfur-containing brightening agent (M.W. 354) is supplied at a concentration of 0.01 g/L, which equates to a concentration of 28 μmol/L (col. 4, line 41-42).

US '840 teaches the use of polyethylene glycol and polypropylene glycol in concentrations of 0.2 g/L and 0.6 g/L, respectively (col. 4, lines 40-68). Both polyethylene glycol and polypropylene glycol have chemical formulas contained in Formula [B]. The molecular weight of the polyalkylene glycols is between 500 and 35000 g/mol (col. 2, lines 2-4), which corresponds to a value of m+k of about 8 to about 800, wherein m=k because the repeating unit is the same.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroless plating bath described by Uzoh et al. and Kishi et al. to use a plating bath having the composition taught by Dahms et al. in either US '171 or US '840 because both solutions have been shown to plate copper having a smooth uniform surface with no voids.

Response to Arguments

16. Applicant's arguments with respect to claims 1-23 have been considered but are moot in view of the new ground(s) of rejection.

17. Due to Applicant's cancellation of claims 1-23 and the addition of claims 24-35, which are based upon an independent claim reciting plating baths as opposed to plating tanks, the positions previously set forth in the prior Office action have been modified to address the new limitations. Therefore, Applicant's arguments do not address the combination of references as applied above.

Conclusion

18. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9310.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

blm
December 11, 2003

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
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